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Open-File Report 90-190

WATER-QUALITY, WELL-CONSTRUCTION, AND GROUND-WATER LEVEL DATA FOR AN INVESTIGATION OF RADIONUCLIDES IN GROUND WATER, HICKMAN AND MAURY COUNTIES, TENNESSEE

Prepared by the
U.S. GEOLOGICAL SURVEY

in cooperation with the
TENNESSEE DEPARTMENT OF HEALTH AND ENVIRONMENT,
DIVISION OF GROUND-WATER PROTECTION and the
U.S. ENVIRONMENTAL PROTECTION AGENCY,
GROUND-WATER PROTECTION BRANCH

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By Gregg E. Hileman

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Nashville, Tennessee

1990

DEPARTMENT OF THE INTERIOR

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CONVERSION FACTORS

Multiply inch-pound unit	By	To obtain metric units
foot (ft)	0.3048	meter (m)
gallon (gal)	0.00379	cubic meter (m^3)
picocurie (pCi)	0.037	becquerel (Bq)

Sea level: In this report "sea level" refers to the National Geodetic Vertical Datum of 1929 (NGVD of 1929)--a geodetic datum derived from a general adjustment of the first-order level nets of both the United States and Canada, formerly called Sea Level Datum of 1929.

Site-numbering systems: The U.S. Geological Survey assigns each site in this report a local Tennessee well number and a station identification number. The local well number is used as a concise label for a site. The station identification number is used as an identifier for site data stored in the national computer data base of the U.S. Geological Survey.

The local well number in Tennessee consists of three parts: (1) an abbreviation of the name of the county in which the well is located; (2) a letter designating the 7 1/2-minute topographic quadrangle on which the well is plotted; and (3) a number generally indicating the numerical order in which the well was inventoried. The symbol Hi:G-023, for example, indicates that the well is located in Hickman County on the "G" quadrangle and is identified as well 23 in the numerical sequence. Quadrangles are lettered from left to right, beginning in the southwest corner of the county.

The station identification number is a unique number for each site based on a latitude and longitude grid system. The number consists of 15 digits. The first 6 digits denotes the degrees, minutes, and seconds of latitude, the next 7 digits denote degrees, minutes, and seconds of longitude, and the last 2 digits (assigned sequentially) identify the wells within a 1-second grid.

Use of trade or product names in this report is for identification purposes only, and does not constitute endorsement by the U.S. Geological survey.

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by Gregg E. Hileman

ABSTRACT

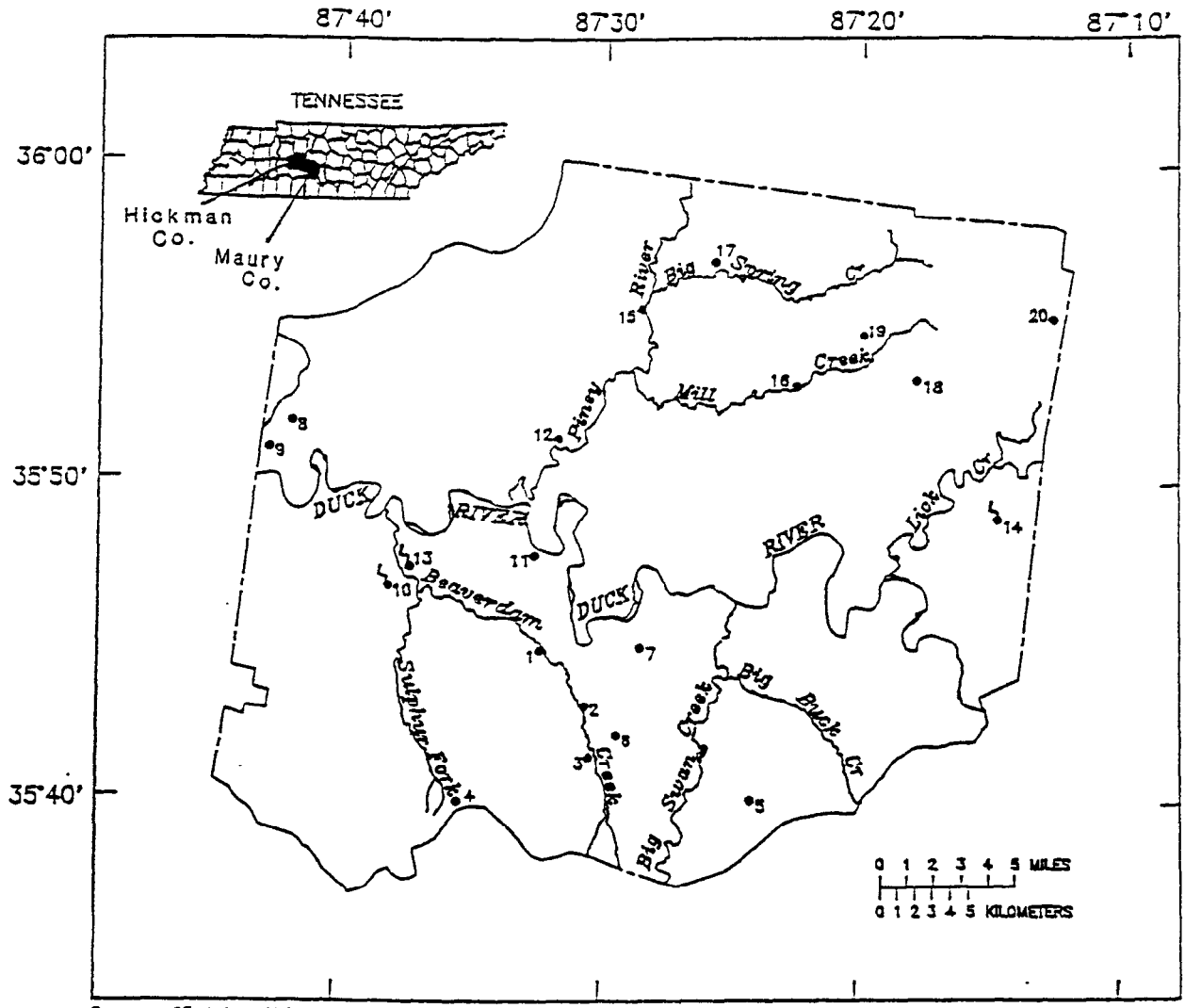
Water-quality, well-construction, and ground-water level data were collected for an investigation of radionuclides in ground water in Maury and Hickman Counties, Tennessee. Seventeen wells and 3 springs were sampled in Hickman County, and 20 wells were sampled in Maury County. Data are presented in tables. Maps of each county show the location of the data-collection sites. Samples from each site were analyzed for radionuclides, common and trace inorganic ions, indicators of redox conditions, selected nutrients, total organic carbon, and selected physical characteristics. Well-construction data were obtained to help determine the source of the water. Where possible, ground-water level measurements were made for each well sampled. Samples were collected from May 1989 through mid-August 1989.

INTRODUCTION

Radionuclides, including uranium, radium, and radon, occur in ground water associated with geologic formations such as black shales and phosphatic limestones. In Middle Tennessee, little is known of the distribution and concentrations of naturally-occurring radionuclides in water associated with these lithologies. During spring and summer of 1989, the U.S. Geological Survey (USGS) conducted a study, in cooperation with the Tennessee Department of Health and Environment, Division of Ground Water Protection, and the U.S. Environmental Protection Agency, Ground-Water Protection Branch, to determine the concentrations and distribution of radionuclides in ground water and the geochemical environment in which they occur. Hickman and Maury Counties, in Middle Tennessee were selected as representative of areas that contain black shale or phosphatic limestone. Seventeen wells and 3 springs were sampled in Hickman County (fig. 1), and 20 wells were sampled in Maury County (fig. 2).

Purpose and Scope

This report presents data collected during the course of the investigation in Hickman and Maury Counties. Included are analyses of water samples for major ions, trace metals, total organic carbon, uranium-234, uranium-238, radium-226, radium-228, radon-222, lead-210, polonium-210, gross alpha and gross beta activity, and physical characteristics. Well-construction data and water-level measurements are also included of wells for which this information was obtainable.



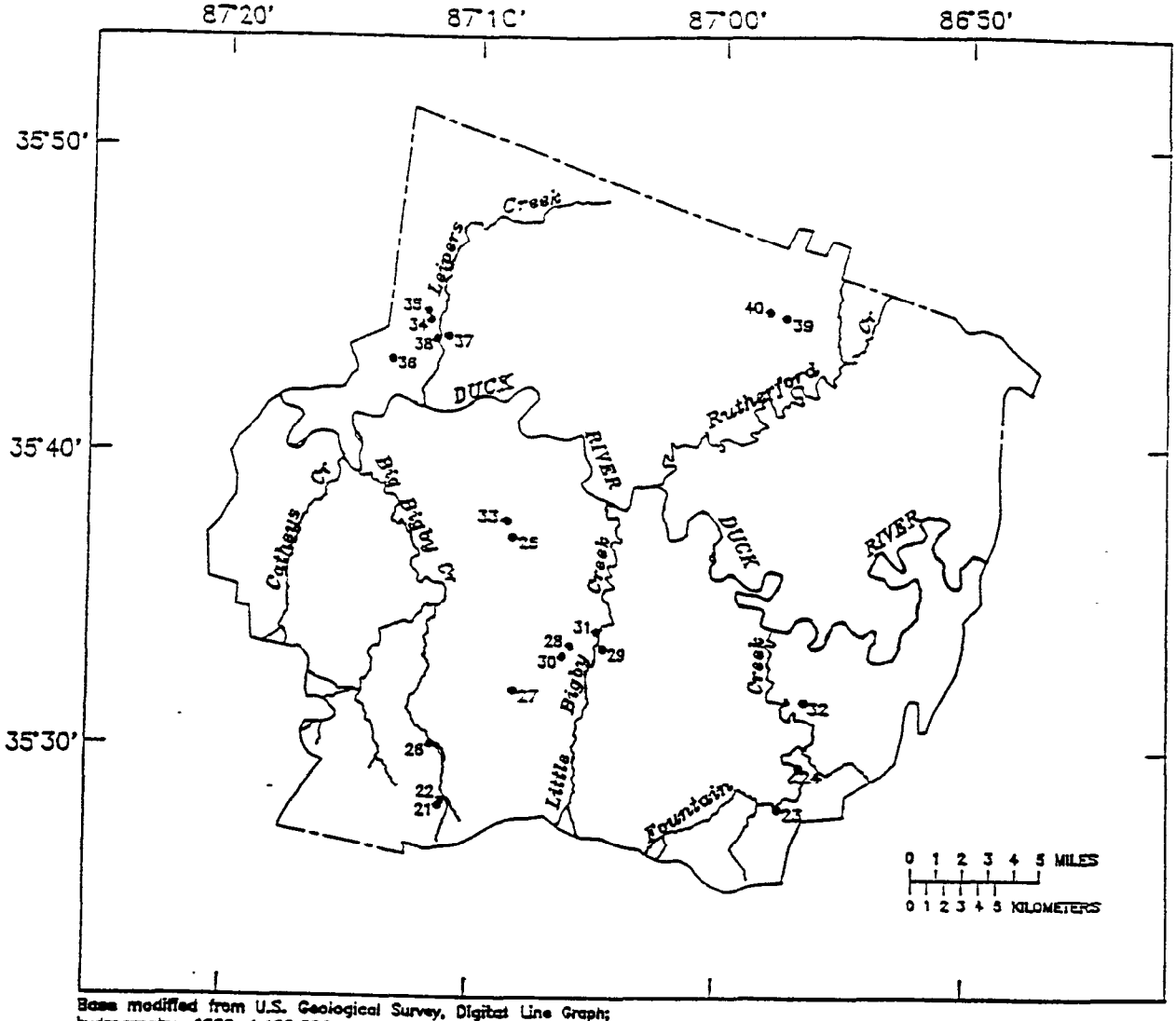
Base modified from U.S. Geological Survey, Digital Line Graph: hydrography, 1980, 1:100,000, county outline, 1980, 1:2,500,000

EXPLANATION

•4 WELL LOCATION AND NUMBER

10 SPRING LOCATION AND NUMBER

Figure 1.—Location of wells and springs sampled in Hickman County, Tennessee.



Base modified from U.S. Geological Survey, Digital Line Graph; hydrography, 1980, 1:100,000, county outline, 1980, 1:2,500,000

EXPLANATION

•23 WELL LOCATION AND NUMBER

Figure 2.--Location of wells sampled in Maury County, Tennessee.

Acknowledgments

The author expresses his appreciation to Jeff Abston and Don Rima, Tennessee Department of Health and Environment, Division of Ground Water Protection, for assistance during sample collection; and to Gene Coker, U.S. Environmental Protection Agency, Ground-Water Protection Branch, for helpful discussions of radionuclide hydrology.

METHODS OF DATA COLLECTION

Hydrologic data were collected at domestic-supply wells and springs using procedures established and documented by the USGS. Field measurements of dissolved oxygen, total iron, ferrous iron, and hydrogen sulfide were made using commercially available methodology. Ground-water sampling protocol adhered to the procedures identified by Claassen (1982). The wells were purged using existing pumps (table 1). Prior to sample collection, wells were pumped for at least 45 minutes at a rate of approximately 2 to 30 gallons per minute in order to obtain a sample representative of water from the aquifer. During pumping, temperature and specific conductivity were monitored. Samples were collected after values for these monitored parameters stabilized for at least 30 minutes, and generally were collected after 3 volumes of casing water were evacuated. The yield from one well (fig. 1, number 2) was too low to allow optimum purging. Samples from this well were collected after slightly more than one casing volume of water was evacuated as the water level reached the pump intake. Springs were sampled from perforated collector pipes inserted into the aquifer or from domestic supply lines tapped into small stilling wells.

Samples were prepared using established procedures whenever possible (Pritt and Jones, 1989). Water temperature, specific conductance, pH, and alkalinity were measured in accordance with the methods of Wood (1976) and Fishman and Friedman (1989). Field meters were calibrated on site, and generally at the same temperature as the water sample. Samples for dissolved analyses were filtered using an acetate membrane filter with a mean pore size of 0.45 micron.

Commercial colorimetry methods were used in the field to determine concentrations of dissolved oxygen, hydrogen sulfide, total iron, and ferrous iron. Dissolved oxygen was analyzed using indigo carmine methodology, by which the color of self-filling CHEMETRICS ampoules were compared to color standards. If the dissolved oxygen concentration was less than 4 milligrams per liter, the concentrations of hydrogen sulfide and iron in 25 milliliter samples were determined using a HACH spectrophotometer. If the dissolved oxygen concentration was 4 milligrams per liter or greater, hydrogen sulfide and iron concentrations were not measured. Hydrogen sulfide concentrations were determined using methylene blue methodology; iron concentrations using phenathroline reagents.

Radon activity was determined using a Lucas cell technique (Reimer, G.M., U.S. Geological Survey, written commun., 1989). Water samples were drawn into evacuated samplers which stripped the water of radon gas and diverted it into calibrated Lucas cells. Radon-222 concentrations were measured by alpha spectrometry using commercially available equipment (Lee and Hollyday, 1987). Counting events were repeated and were of sufficient duration to achieve an analytical error of less than 3 percent for all samples. Two samples were collected at each site (table 2). At most sites, the first sample was collected

Table 1.--Site-number, well-construction, and water-level data for wells and springs sampled in Hickman and Maury Counties

[Altitudes determined from U.S. Geological Survey (USGS) 7 1/2-minute topographic maps. Primary aquifers: BGBC, Bigby and Cannon Limestones; CRRS, Carters Limestone; FRPN, Fort Payne Formation; HRMG, Hermitage Formation; LBNH, Lebanon Limestone; LPIC, Leipers-Inman-Catheys Formations undifferentiated; NSVL, Nashville Group; WYNE, Wayne Group; WRSW, Warsaw Formation. Pump type: C, suction; J, Jet; S, submersible; -, indicates that no pump was used; --, indicates data not available; *, indicates that the site is a spring; and **, indicates screened well.]

Map number	USGS local Tennessee well number	USGS station identification number	Depth of well below land surface, in feet	Screened or open interval, in feet	Altitude of land surface above sea level, in feet	Primary aquifer	Water level below land surface datum		Pump type
							Depth, in feet	Date	
1	Hi:E-013	354438087322701	340	--	600	NSVL	--	--	S
2	Hi:E-014	354253087303801	226	39-226	630	BGBC	--	--	S
3	Hi:E-015	354117087302601	55	51- 55	630	FRPN	--	--	S
4	Hi:E-016	353941087350501	280	--	920	FRPN	--	--	S
5	Hi:F-005	354020087241701	100	20-100	630	NSVL	--	--	J
6	Hi:F-006	354200087291801	--	--	820	FRPN	--	--	S
7	Hi:F-007	354444087282301	55	--	550	LPIC	--	--	J
8	Hi:J-006	355143087415301	300	166-300	580	FRPN	--	--	S
9	Hi:J-007	355053087424401	--	--	510	FRPN	--	--	S
10	Hi:J-008*	354635087380601	--	--	495	FRPN	--	--	C
11	Hi:K-005	354736087324401	190	62-190	600	NSVL	--	--	S
12	Hi:K-006	355119087314401	146	64-146	550	WYNE	--	--	S
13	Hi:K-009*	354713087371501	--	--	460	FRPN	--	--	-
14	Hi:N-003*	354852087144201	--	--	625	FRPN	--	--	-
15	Hi:Q-007	355521087283101	300	79-300	540	NSVL	--	--	S

Table 1.--Site-number, well-construction, and water-level data for wells and springs sampled in Hickman and Maury Counties--Continued

Map number	USGS local Tennessee well number	USGS station identification number	Depth of well below land surface, in feet	Screened or open interval, in feet	Altitude of land surface above sea level, in feet	Primary aquifer	Water level below land surface datum: Depth, in feet	Water level below land surface datum: Date	Pump type
16	Hi:Q-008	355300087222701	65	--	635	FRPN	--	--	J
17	Hi:Q-009	355652087253901	200	180-200**	750	FRPN	164.8	6/14/89	S
18	Hi:R-025	355312087175001	180	--	845	FRPN	46.0	6/ 9/89	S
19	Hi:R-026	355436087195501	107	--	880	WRSW	--	--	J
20	Hi:S-005	355511087123401	120	63-120	920	FRPN	56.5	6/ 1/89	S
21	My:B-005	352806087111001	125	--	800	HRMG	19.6	7/11/89	S
22	My:B-006	352815087110401	--	--	845	NSVL	--	--	J
23	My:D-002	352805086572801	275	20-275	720	LBNN	68.9	7/12/89	J
24	My:D-003	352928086564001	62	--	725	LBNN	--	--	S
25	My:F-003	353703087083201	85	--	670	HRMG	--	--	J
26	My:F-004	353009087113401	85	--	695	BGBC	4.0	7/18/89	S
27	My:F-005	353159087082401	150	--	740	HRMG	37.1	7/20/89	S
28	My:G-013	353328087060701	456	28-456	790	CRRS	113.0	8/21/89	S
29	My:G-014	353323087044001	125	35-125	700	HRMG	36.9	8/21/89	J
30	My:G-015	353308087062701	365	--	940	HRMG	--	--	S
31	My:G-016	353357087045901	8	--	640	HRMG	6.8	8/23/89	C
32	My:H-022	353141086563201	190	55-190	705	LBNN	--	--	S
33	My:L-005	353734087084501	39	35- 39	670	HRMG	5.9	7/14/89	S
34	My:L-006	354410087115701	85	--	600	HRMG	--	--	S
35	My:L-007	354427087120601	--	--	650	BGBC	--	--	S
36	My:L-008	354251087133201	225	--	880	FRPN	50.6	7/17/89	S
37	My:L-009	354338087111001	150	--	630	HRMG	--	--	J
38	My:L-010	354333087114201	38	--	580	HRMG	13.1	7/26/89	J
39	My:N-030	354420086573001	60	42- 60	710	HRMG	22.0	8/11/89	S
40	My:N-034	354432086580901	60	--	690	HRMG	12.3	8/11/89	S

Table 2.--Water-quality data for water from wells and springs sampled in Hickman and Maury Counties

[mg/L, milligrams per liter; ug/L, micrograms per liter; pCi/L, picocuries per liter; H:MM, hours:minutes; deg C, degrees Celsius; uS/cm, microsiemens per centimeter. Value given as < (less than) indicates that the concentration was below the detection level of the analytical method used and does not indicate the presence or absence of the constituent; >, indicates that the concentration was greater than the value shown; --, indicates data not available.]

Map number	Date sampled	Temperature water (deg C)	Specific conductance (uS/cm)	pH (standard units)	Oxygen, dissolved (mg/L)	Alkalinity, water, whole, total, incremental titration field, mg/L as $CaCO_3$	Solids, residue at 180 deg C dissolved (mg/L)	Calcium, dissolved (mg/L as Ca)	Magnesium, dissolved (mg/L as Mg)	Sodium, dissolved (mg/L as Na)
1	05-09-89	15.5	135	7.4	4	63	85	24	3.7	2.4
2	06-23-89	17.5	980	7.5	3	120	725	100	43	38
3	05-19-89	15	62	6.6	8	32	26	11	1.1	1.4
4	06-15-89	16.5	165	7.3	5.5	93	104	32	3.8	3.2
5	05-24-89	16	580	7.3	1.3	170	518	160	20	3.8
6	06-13-89	17	150	6.7	5.5	70	88	26	2.5	1.8
7	06-21-89	16	450	7.1	2	200	287	81	10	2.7
8	05-15-89	15.5	134	6.8	6	65	66	24	2.1	2.5
9	05-18-89	16	144	6.6	2	56	56	15	2.4	3.7
10	05-24-89	16	95	6.5	7	48	56	16	1.9	1.7
11	05-17-89	15	1150	7.4	.14	130	901	220	23	8
12	05-30-89	16	197	7.0	5.5	85	108	35	3.2	1.6
13	07-10-89	15.5	60	6.8	6	33	45	9.7	1.5	1.2
14	06-07-89	14	185	7.3	5	96	113	32	4.7	1.2
15	05-11-89	15	390	7.6	4	200	222	67	11	4.2
16	06-07-89	15.5	327	7.4	5	150	176	50	7.1	5.6
17	06-14-89	15	275	7.4	5.5	140	149	48	6	1.4
18	06-09-89	15.5	260	7.6	5	130	154	45	5.5	1.2
19	06-14-89	16	450	7.3	4.5	220	253	86	5.3	6
20	06-01-89	15	150	7.2	8	68	101	25	3.5	2.3

Table 2.--Water-quality data for water from wells and springs sampled in Hickman and Maury Counties--Continued

Map number	Date sampled	Temperature water (deg C)	Specific conductance (uS/cm)	pH (standard units)	Oxygen, dissolved (mg/L)	Alkalinity, water, whole, total, incremental titrations field mg/L as $CaCO_3$	Solids, residue at 180 deg C dissolved (mg/L)	Calcium, dissolved (mg/L as Ca)	Magnesium, dissolved (mg/L as Mg)	Sodium, dissolved (mg/L as Na)
21	07-11-89	17.5	530	7.4	3	--	224	52	17	2.7
22	07-11-89	17.5	480	--	1.3	--	286	87	9	2.4
23	07-12-89	16	650	7.2	--	300	232	110	7.7	1.1
24	07-20-89	17	585	6.8	3	300	337	120	5.5	4.1
25	07-13-89	20	390	6.8	1.6	160	230	73	2.8	4.4
26	07-18-89	19	500	7.1	4	180	300	78	5.4	19
27	07-20-89	16	695	7.3	.19	330	429	94	41	5.2
28	08-21-89	17	485	6.9	.24	190	271	70	23	3.8
29	08-21-89	16	660	6.9	1.6	250	238	120	14	5.8
30	08-22-89	17	390	6.8	1.9	150	221	51	18	6.6
31	08-23-89	18	420	6.4	6	210	266	88	4	1.8
32	07-12-89	16.5	900	7.9	.2	220	522	32	18	140
33	07-14-89	16.5	340	7.6	.14	170	150	41	19	3
34	07-17-89	16.5	1500	7.2	.28	320	1160	130	74	100
35	07-18-89	18.5	500	7.3	.14	210	299	70	22	4.3
36	07-17-89	16	410	7.2	1.6	160	242	65	6.4	9.4
37	07-26-89	17	510	7.3	1.7	240	248	95	10	2.5
38	07-26-89	14.5	505	7.2	2.3	260	291	96	11	2.7
39	08-11-89	15.5	420	6.9	--	180	252	80	5.2	2.6
40	08-11-89	16	1610	6.8	7	290	961	250	31	15

Table 2.--Water-quality data for water from wells and springs sampled in Hickman and Maury Counties--Continued

Map number	Potassium, dissolved (mg/L as K)	Chloride, dissolved (mg/L as Cl)	Sulfate, dissolved (mg/L as SO_4)	Fluoride, dissolved (mg/L as F)	Silica, dissolved (mg/L as SiO_2)	Nitrogen ammonia, dissolved (mg/L as N)	Nitrogen NO_2+NO_3, dissolved (mg/L as N)	Phosphorous ortho, dissolved (mg/L as P)	Carbon, organic total (mg/L as C)	Barium, dissolved (ug/L as Ba)	Boron, dissolved (ug/L as B)
1	1.2	2.2	9	0.1	7.9	0.02	0.40	0.02	<0.1	130	10
2	2.9	11	390	.3	11	.34	< .10	< .01	.4	17	220
3	.5	1	<1	.1	8.8	.03	.20	.02	.1	33	<10
4	.3	2.7	4	.1	8.7	.02	.30	< .01	< .1	16	10
5	1.5	1.3	310	.4	10	.04	.13	< .01	.5	19	50
6	.5	1.8	3	.1	8.0	.02	.21	.03	.1	25	<10
7	1	1.5	38	.3	9.5	.02	< .10	.10	.3	22	50
8	.4	1.8	1	.1	8.8	.02	.65	.04	.1	56	<10
9	.5	2.2	2	.1	8.7	.03	.89	.01	.1	31	<10
10	.4	1.4	1	< .1	8.7	.02	.18	.02	.3	35	<10
11	1.5	4.8	530	.1	8.1	.15	< .10	.01	.1	28	30
12	.4	1.2	8	.1	8.6	.02	.36	.09	.2	17	20
13	.4	1	3	< .1	8.8	< .01	< .10	.01	< .1	16	<10
14	.1	1.4	3	.1	8.6	--	--	--	.1	17	<10
15	.9	5.5	10	.1	8.7	.01	1.80	.02	< .1	56	<10
16	4.8	4.1	10	.1	7.9	--	--	--	.1	47	20
17	.2	1.8	2	.1	8.1	.02	.28	.03	.2	15	<10
18	.1	1.6	<1	.1	8.3	--	--	--	< .1	11	<10
19	.5	7.6	5	.1	9.1	.03	1.70	< .01	.1	26	10
20	.2	1	1	.1	9.2	.01	2.50	.05	.1	13	<10
21	2.3	1.5	37	.9	8.9	.02	.51	.16	.1	23	30
22	.8	3.3	29	.2	9.1	.03	.69	.23	--	9	20
23	.4	1	22	.1	4.9	.02	.12	< .01	1	11	20
24	1.6	3.8	15	.1	7.5	.03	.92	.04	1.4	33	20
25	.5	2.9	29	.2	7.7	.01	1.10	.40	.3	9	20
26	3.1	33	20	.2	8.9	.01	.90	.15	.9	10	20
27	1.9	8.2	65	.4	11	.04	< .10	.14	.1	26	80
28	1	2.4	54	1.3	10	< .01	< .10	.03	.2	44	40
29	.6	5.6	91	.5	8.2	.02	.94	.06	.6	40	40
30	1	2.8	49	.9	9.1	< .01	.71	.02	< .1	37	40
31	.5	2.4	8	.2	9.5	.01	2.90	.63	.2	12	<10
32	4.5	99	95	4	9.4	.04	< .10	.05	< .1	13	730
33	.7	1.4	12	1.1	8.7	.02	< .10	< .01	< .1	36	20
34	5.2	29	550	1.8	8.2	.29	1.70	< .01	.3	9	690
35	1.7	4	55	.8	9.2	.09	< .10	.01	.5	4	80
36	1.4	12	7	.2	8.2	< .01	7.80	< .01	.2	34	20
37	1	4.9	28	.3	6.9	.02	< .10	.09	1.3	13	60
38	.7	1.7	28	.3	7.7	.01	< .10	.16	.4	13	20
39	.5	6.4	28	.2	8.6	.03	1.90	.44	.3	4	30
40	3.4	6.4	470	.5	7.9	.12	.78	.12	.5	31	160

Table 2.--Water-quality data for water from wells and springs sampled in Hickman and Maury Counties--Continued

Map number	Strontium, dissolved (ug/L as Sr)	Aluminum, dissolved (ug/L as Al)	Lithium, dissolved (ug/L as Li)	Iron, dissolved (ug/L as Fe)	Manganese, dissolved (ug/L as Mn)	Iron, total recoverable (ug/L as Fe)	Iron, ferrous dissolved (ug/L as Fe)	Hydrogen sulfide, total (mg/L as H_2S)	Gross alpha, dissolved (ug/L as U-nat)	Gross beta, dissolved (pCi/L as Cs-137)	Uranium natural, dissolved (pCi/L)
1	98	<10	<4	13	14	--	--	--	0.9	1.7	0.31±.03
2	7700	<10	100	38	8	60	60	>0.50	9.4	10	.16±.03
3	30	<10	<4	7	<1	--	--	--	.8	1.1	.07±.02
4	350	<10	<4	7	2	--	--	--	1.4	.6	.09±.02
5	880	<10	19	41	4	2100	20	< .01	1.4	3	.12±.02
6	79	<10	<4	4	2	--	--	--	1.9	1.6	.19±.03
7	350	<10	4	<3	<1	<10	--	.01	1	2.1	.12±.02
8	120	<10	<4	9	1	--	--	--	.6	< .4	.09±.02
9	18	<10	<4	7	25	--	--	--	3.8	1.4	1.44±.06
10	55	<10	<4	3	<1	--	--	--	.8	1.1	.05±.02
11	43	<10	22	1000	16	--	--	< .01	5	5.5	.82±.06
12	43	<10	<4	14	1	--	--	--	.9	1	.12±.03
13	26	<10	<4	<3	3	--	--	--	< .4	.7	.02±.01
14	68	<10	<4	4	1	--	--	--	< .4	.8	.04±.01
15	110	<10	7	9	1	--	--	--	.5	1.1	.16±.02
16	130	<10	<4	<3	<1	--	--	--	2.9	5.7	.24±.05
17	80	<10	<4	3	<1	--	--	--	1.1	.9	.14±.02
18	51	<10	4	<3	<1	--	--	--	.4	3.8	.04±.01
19	120	<10	<4	5	7	--	--	--	< .4	2	.26±.03
20	120	<10	<4	4	<1	--	--	--	.4	.7	.06±.02
21	5900	<10	7	10	10	--	--	--	1.5	2.6	.07±.02
22	790	<10	<4	<3	<1	--	--	--	< .4	.9	< .01± --
23	280	<10	5	<3	<1	<10	<10	< .01	< .4	.8	.10±.02
24	180	<10	6	8	7	240	80	.03	< .4	3.7	.30±.03
25	130	<10	<4	9	3	40	10	< .01	< .4	< .4	< .01± --
26	180	<10	<4	4	3	<10	--	.04	< .4	3.8	.14±.02
27	2700	<10	13	34	14	70	10	< .01	.5	2.6	.15±.02
28	6400	<10	11	8	11	<10	--	< .01	--	--	.27±.03
29	950	<10	10	25	1	100	20	< .01	--	--	.14±.02
30	1300	<10	11	5	<1	100	<10	< .01	--	--	.23±.03
31	150	<10	6	5	<1	<10	--	< .01	--	--	.06±.02
32	5000	<10	430	110	1	180	120	.12	1.3	3.6	< .01± --
33	1100	<10	4	18	3	50	30	.06	< .4	.5	< .01± --
34	5400	<10	240	200	33	--	180	> .50	4.1	9.2	.03±.01
35	1400	<10	10	15	6	50	--	< .01	.6	2	.02±.01
36	1100	<10	11	24	51	<10	--	< .01	1.6	2.3	.06±.02
37	300	<10	6	11	1	100	60	< .01	.6	4.7	.22±.02
38	410	<10	8	5	<1	120	60	< .01	.9	2.7	.19±.02
39	130	<10	6	50	<1	20	10	< .01	--	--	.03±.01
40	2700	<10	29	140	3	260	150	> .50	--	--	1.51±.07

Table 2.--Water-quality data for water from wells and springs sampled in Hickman and Maury Counties--Continued

Map number	Uranium, dissolved isotope ratio (U-234/ U-238)	Radium 228, dis- solved (pCi/L)	Radium 226, dis- solved (pCi/L)	Lead 210 water whole, total (pCi/L)	Polonium 210 water whole, total (pCi/L)	Radon-222, total			
						First sample (pCi/L)	Second sample (pCi/L)	Time between samples (H:MM)	Total discharge between samples (gallons)
1	1.42±.13	0.03±.01	0.06±.01	--	--	347	1190	0:16	130
2	2.67±.42	.17±.01	2.57±.18	--	--	337	422	1:32	130
3	1.33±.34	.02±.01	.11±.02	0.08	0.17	754	857	1:46	1400
4	2.37±.48	.03±.02	.11±.04	--	--	554	563	:13	50
5	2.32±.39	.15±.04	.34±.10	--	--	157	--	--	--
6	1.17±.19	.05±.02	.22±.09	--	--	742	693	:52	310
7	1.42±.17	--	.02±.14	--	--	309	519	2:20	280
8	.87±.19	--	--	--	--	900	602	2:12	870
9	1.76±.08	.08±.02	.73±.17	--	--	1000	754	1:54	400
10	3.95±.98	.03±.01	.06±.01	--	--	631	686	1:10	110
11	5.81±.54	.38±.02	.94±.05	--	--	201	--	--	--
12	3.21±.75	.20±.04	.33±.07	--	--	246	640	:59	80
13	1.27±.38	.03±.02	.06±.03	.09	.09	680	700	:18	--
14	3.34±.83	.08±.01	.19±.02	--	--	286	327	2:21	--
15	1.50±.21	.03±.02	.07±.04	--	--	104	62	--	--
16	1.64±.31	.05±.01	.21±.02	--	--	562	510	1:54	340
17	2.94±.49	.02±.01	.06±.04	--	--	237	333	2:09	840
18	2.11±.61	.01±.01	.01±.01	--	--	258	254	1:45	630
19	1.76±.22	.07±.06	.07±.06	--	--	225	425	1:54	100
20	1.76±.51	.06±.02	.08±.02	--	--	310	331	1:57	240
21	2.46±.64	.05±.01	.16±.04	--	--	230	437	1:55	230
22	--	.06±.03	.09±.05	--	--	437	498	2:19	280
23	2.06±.43	.02±.05	.02±.05	--	--	281	305	1:34	380
24	1.64±.16	.46±.05	.37±.14	--	--	902	969	1:29	220
25	--	.01±.02	.02±.04	.07	.38	1470	1490	1:39	250
26	1.78±.27	<.01	<.01	--	--	714	567	1:16	2000
27	3.61±.42	.05±.03	.07±.04	--	--	109	113	1:32	640
28	4.22±.5	.09±.03	.23±.06	--	--	68	80	2:09	190
29	1.71±.32	.03±.01	.07±.02	--	--	161	451	3:08	1200
30	2.18±.3	.02±.01	.03±.01	--	--	194	206	2:26	360
31	2.81±.72	<.01	<.01	--	--	1130	1090	2:22	330
32	--	.03±.01	.05±.01	--	--	254	236	1:58	600
33	--	.03±.02	.06±.04	--	--	63	63	2:58	630
34	3.59±.77	.27±.04	.47±.06	--	--	87	94	2:27	400
35	2.71±.67	.04±.02	.20±.08	--	--	264	240	1:20	120
36	2.08±.40	.15±.05	.25±.09	--	--	318	317	1:09	50
37	1.33±.15	.04±.01	.09±.03	--	--	351	407	2:04	350
38	1.37±.17	.02±.01	.04±.02	.14	.13	916	711	1:49	660
39	1.98±.45	.02±.01	.03±.02	--	--	459	562	1:17	120
40	1.62±.08	.03±.02	.07±.03	--	--	510	588	1:26	120

after discharging approximately one casing volume of water; the second sample was usually collected after three casing volumes had been evacuated.

Three laboratories conducted the non-field analyses. The USGS National Water Quality Laboratory in Arvada, Colorado, conducted most of the laboratory analyses and used analytical procedures described by Pritt and Jones (1989). Analytical reruns were conducted for questionable values. The USGS National Research Program Laboratory in Reston, Virginia analyzed water samples for the radioisotopes: uranium-234, uranium-238, radium-226, and radium-228. Uranium analyses by alpha spectrometry techniques followed precipitation-extraction procedures (Kraemer, 1981). Radium-226 was determined by radon emanation techniques (Shink and others, 1970). Radium-228 was determined by gamma spectrometry to establish radium-228 to radium-226 ratios from large volume samples (Michel and others, 1981) and multiplying that ratio by the radium-226 value found by emanation. The U.S. Environmental Protection Agency Eastern Environmental Radiation Facility in Montgomery, Alabama analyzed water samples for lead-210 and polonium-210 using established methodologies of that laboratory (U.S. Environmental Protection Agency, 1984).

DATA PRESENTATION

Data collected for this study are presented in two tables and the sites sampled are shown on two maps. Site numbers and physical characteristics of the sites including well-construction and water-level data are presented in table 1. Water-quality data including radioisotope data are presented in table 2. The study area and site locations are shown in figures 1 (Hickman County) and 2 (Maury County).

All analytical results are stored in the USGS National Water Information System data base. The data are also stored in the STORET national data base maintained by the U.S. Environmental Protection Agency.

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